

APPENDIX E.

Analysis of U.S. Census of Population Data

The study team utilized U.S. Census data from the 1980, 1990 and 2000 U.S. Census 5% Public Use Micro-samples (PUMS data) to analyze:

- Demographic characteristics of workers in construction and engineering, including related occupations;
- Educational attainment; and
- Self-employment (business ownership).

PUMS offers several features ideal to the analyses reported in this study, including historical cross-sectional data; stratified national and state-level samples; large sample sizes, even for subsets of the population (e.g., ethnic and occupational groups); and robust variables for statistically significant estimates.

BBC obtained selected Census data via the Minnesota Population Center's Integrated Public Use Micro-data Series (IPUMS). The IPUMS program provides access to customized, accurate data extracts. These data are available at the IPUMS web site.¹

Data for 2000

The 2000 U.S. sample contains 14,081,466 observations. Applying the Census person-level population weights, this sample represents 281,421,906 people in the United States. The 2000 California sub-sample contains 1,690,642 individual observations, weighted to represent 33,884,660 people in the state.

Categorizing individual race/ethnicity. To define race/ethnicity for the 2000 Census data set, BBC used the IPUMS race variable with the greatest level of detail and categorized each race type into one of seven groups:

- Non-Hispanic white;
- Hispanic American;

¹ Steven Ruggles, Matthew Sobek, Trent Alexander, Catherine A. Fitch, Ronald Goeken, Patricia Kelly Hall, Miriam King, and Chad Ronnander. *Integrated Public Use Microdata Series: Version 3.0* [Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor], 2004.
<http://usa.ipums.org/usa/>

- African-American;
- Asian-Pacific American;
- Subcontinent Asian American;
- Native American; and
- Other minority (unspecified)

An individual is considered "non-Hispanic white" if not Hispanic and not in combination with any other race group. Any self-identified Hispanic individuals are considered Hispanic American, regardless of any other race group identification.

For the five other race groups, an individual's race/ethnicity is categorized by the first (or only) race group identified in each possible race-type combination. BBC uses a rank ordering methodology which complements the 2000 Census data dictionary rank ordering. African-American is first, followed by Native American, then Asian-Pacific American and finally Subcontinent Asian American. For example, if an individual identified "Korean," this person belongs in the Asian-Pacific American category, whereas, if the individual identified "Korean" in combination with "Black," the individual is considered African-American. Hispanic identification overrules any other race group identification.

- The Asian-Pacific American category includes the following race/ethnic groups: Cambodian, Chamorro, Chinese, Filipino, Guamanian, Hmong, Indonesian, Japanese, Korean, Laotian, Malaysian, Samoan, Taiwanese, Thai, Tongan, and Vietnamese. This category also includes other Polynesian, Melanesian and Micronesian races as well as individuals identified as Pacific Islanders.
- The Subcontinent Asian American category includes these race groups: Asian Indian (Hindu), Bangladeshi, Pakistani, and Sri Lankan. Any individuals identified as "Asian," but not clearly categorized as Asian-Pacific versus Subcontinent Asian, are put into the Asian-Pacific group. (Overall, nine in ten Asians counted in the 2000 Census in California were Asian-Pacific Americans.)
- American Indian, Alaskan Native, Hawaiian and Latin American Indian groups are considered Native American.
- If an individual is identified with any of the above groups and an "other race" group, the individual is categorized into the known category. Individuals identified as "Other race" or "White and other race" are categorized as "Other minority."

The exception to the rules listed above applies to individuals who are Asian-Pacific American in combination with Hawaiian. An individual identified as Hawaiian alone is considered Native American. Individuals who are a combination of Native American and Asian-Pacific are considered Native American in all cases except those identified as Hawaiian Native Americans. These individuals are considered primarily Asian-Pacific.

Business ownership. BBC uses the Census "class of worker" variable (CLASSWKD) to determine self-employment. Individuals are classified into eight categories:

- Self-employed for a non-incorporated business,
- Self-employed for an incorporated business,
- Wage or salary employee for a private firm,
- Wage or salary employee for a non-profit organization,
- Employee of the Federal government,
- Employee of a State government,
- Employee of a local government, or
- Unpaid family worker.

BBC included as business owners individuals who reported self-employment, either for an incorporated or a non-incorporated business.

Defining selected industry sectors. The construction sector is defined using the 2000 Census code for the industry, 077, which is equivalent to the 1997 NAICS code 23. The Architectural, Engineering and Related Services industry is Census code 729, corresponding to 1997 NAICS code 5413.

Relevant engineering occupational titles. When referring to engineering as an occupation, BBC included civil (136), environmental (142), mining and geological engineers (150). The Census codes for these occupational titles (in parentheses) tie to Standard Occupational Classification (SOC) codes 17-2051, 17-2081 and 17-2151, respectively.

Education variables. BBC used the variable denoting the highest level of educational attainment to classify individuals into the following four categories: less than high school, high school diploma, some college and at least a bachelor's degree.

Definition of workers. The universe for the class of worker, industry and occupation variables includes individuals over the age of 16 who reported last working within the five years preceding the Census survey.

Comparisons Over Time

BBC utilized IPUMS data from the 1980, 1990 and 2000 Censuses to analyze changes in worker demographics, educational attainment and business ownership over time.

Changes in race/ethnicity categories between censuses. Figure E-1 lists the seven BBC-defined race/ethnic categories with the corresponding 2000, 1990 and 1980 Census race groups. The comparability of specific race/ethnic categories is relatively straightforward between 1980 and 1990. However, the U.S. Bureau of the Census introduced a combination of race types in 2000. Individuals could select multiple races when responding to the 2000 Census questionnaire.

For example, an individual who is primarily white, yet with one quarter of Native American ancestry, could choose the "White and American Indian/Alaska Native" race group in 2000. However, if the same individual must choose a single race, as in prior years, the choice may either be "white" or "American Indian/Alaska Native." The choice depends on unknowable factors including how strongly the individual identifies with his or her Native heritage. In addition, the data analyst does not have information about the proportions of individual ancestry, and will only know that the ancestry is mixed. The variability introduced by allowing multiple race selection complicates direct comparisons between race data from the 2000 Census and previous censuses. Even so, 98 percent of survey respondents in 2000 indicated a single race.²

² Grieco, Elizabeth M. & Rachel C. Cassidy. "Overview of Race and Hispanic Origin," *Census 2000 Brief*, March 2001, page 3.

Figure E-1.
BBC race/ethnic categories compared with
Census race and Hispanic Origin survey questions, 1980-2000

BBC-defined race/ethnic categories	2000 Census	1990 Census	1980 Census
African-American	Hispanic origin: no Race: Black/Negro alone or in combination with any other non-Hispanic group	Hispanic origin: no Race: Black/Negro	Hispanic origin: no Race: Black/Negro
Asian-Pacific American	Hispanic origin: no Race: Chinese, Taiwanese, Japanese, Filipino, Korean, Vietnamese, Cambodian, Hmong, Laotian, Thai, Indonesian, Malaysian, Samoan, Tongan, Polynesian, Guamanian/Chamorro, Pacific Islander, Micronesian, Melanesian, or other Asian, either alone or in combination with any non-Hispanic, non-Black, or non-Native American groups. <i>Does include Asian-Pacific in combination with Hawaiian.</i>	Hispanic origin: no Race: Chinese, Taiwanese, Japanese, Filipino, Korean, Vietnamese, Cambodian, Hmong, Laotian, Thai, Burmese, Indonesian, Malaysian, Okinawan, Samoan, Tahitian, Tongan, Guamanian/Chamorro, Northern Mariana Islander, Palauan, Fijian, Pacific Islander, Micronesian, Melanesian, other Polynesian, or other Asian	Hispanic origin: no Race: Chinese, Japanese, Filipino, Korean, Vietnamese, Pacific Islander or other Asian
Subcontinent Asian American	Hispanic origin: no Race: Asian Indian, Bangladeshi, Pakistani or Sri Lankan, alone or in combination with white or other groups only	Hispanic origin: no Race: Asian Indian, Bangladeshi, Pakistani or Sri Lankan	Hispanic origin: no Race: Asian Indian
Hispanic American	Hispanic origin: yes Race: any race groups, alone or in combination with other groups	Hispanic origin: yes Race: any	Hispanic origin: yes Race: any, - OR - Hispanic origin: no Race: Spanish
Native American	Hispanic origin: no Race: American Indian or Alaskan Native tribe identified, or Hawaiian, alone or in combination with any non-Hispanic, non-Black group. <i>Does not include Asian-Pacific in combination with Hawaiian.</i>	Hispanic origin: no Race: American Indian or Alaskan Native tribe identified, or Hawaiian	Hispanic origin: no Race: American Indian/Alaska Native or Hawaiian
Other minority group	Hispanic origin: no Race: other race alone or in combination with white only	Hispanic origin: no Race: other race	Hispanic origin: no Race: other race

Non-Hispanic white	Hispanic origin: no Race: white alone	Hispanic origin: no Race: white	Hispanic origin: no Race: white
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Source: BBC Research and Consulting from the IPUMS program: <http://usa.ipums.org/usa/>.

Although there are fewer race types in the 1980 data, the 1990 race types fall into 1980 categories. However, by using two categories of Asian individuals, BBC loses some accuracy when comparing Asian individuals between 1980 and 1990: individuals identified as Bangladeshi, Pakistani and Sri Lankan are categorized as "Subcontinent Asian American" in 1990, yet these race groups are not included in 1980. In 1980, the same individuals would be included in the "Other Asian" race type, and therefore categorized by BBC as "Asian-Pacific American." Together, these three groups accounted for 0.04 percent of the 1990 sample.

Business ownership. BBC uses the Census "class of worker" variable (CLASSWKD) to determine self-employment. This variable is the same for 1980, 1990 and 2000.

Changes in industry codes between censuses. The Construction sector is coded as "077" in the 2000 Census, and "060" in the 1990 and 1980 Censuses. The 2000 Census includes the "Architectural, Engineering and Related Services" industry as code "729." In 1980 and 1990, the code is "882" for "Engineering, Architectural and Surveying Services."

Changes in occupational codes between censuses. Occupational titles and codes vary between censuses. BBC makes the following adjustments:

- Codes used to determine the occupational (versus industry) category of engineer. The 1980 and 1990 Censuses do not include specific categories for environmental or geological engineers, so these are omitted when comparing populations over time by engineering occupation. Instead, BBC focuses on civil engineers, coded as "136" in 2000, or "53" in 1980 and 1990.
- Codes used to determine occupations within the construction industry. Figure E-2 contains the occupational code crosswalk and all job descriptions.

Changes in educational variables between censuses. The 1990 and 2000 Censuses provide the same educational attainment variables, which denote the highest degree achieved, but the 1980 Census uses a highest-grade completed variable. In order to compare educational attainment from 1980 to 1990 or 2000, BBC made the following assumptions:

- An individual has less than a high school diploma the individual is attending 12th grade or at any lower grade level.
- An individual who completed 12th grade is considered a high school graduate.

- An individual who completed at least 12th grade, but less than completion of four years of college is categorized under "some college."
- An individual who completed at least four years of college is categorized as receiving at least a bachelor's degree.

Figure E-2.
Occupational crosswalk for 1980 and 2000 IPUMS data

Census 2000 Occupational title and code	Census 1980 Occupational title and code	Job description for 2000 titles
Construction laborers 626	Construction laborers 869	Perform tasks involving physical labor at building, highway, and heavy construction projects, tunnel and shaft excavations, and demolition sites. May operate hand and power tools of all types: air hammers, earth tampers, cement mixers, small mechanical hoists, surveying and measuring equipment, and a variety of other equipment and instruments. May clean and prepare sites, dig trenches, set braces to support the sides of excavations, erect scaffolding, clean up rubble and debris, and remove asbestos, lead, and other hazardous waste materials. May assist other craft workers. Exclude construction laborers who primarily assist a particular craft worker, and classify them under "Helpers, Construction Trades."
Cement masons, concrete finishers and terrazzo workers 625	Concrete and terrazzo finishers 588	Smooth and finish surfaces of poured concrete, such as floors, walks, sidewalks, or curbs using a variety of hand and power tools. Align forms for sidewalks, curbs or gutters; patch voids; use saws to cut expansion joints. Terrazzo workers apply a mixture of cement, sand, pigment or marble chips to floors, stairways, and cabinet fixtures.
Iron and steel workers, including reinforcing iron and rebar workers 653	Structural metal workers 597	<i>Iron and steel workers</i> raise, place, and unite iron or steel girders, columns, and other structural members to form completed structures or structural frameworks. May erect metal storage tanks and assemble prefabricated metal buildings. <i>Reinforcing iron and rebar workers</i> position and secure steel bars or mesh in concrete forms in order to reinforce concrete. Use a variety of fasteners, rod-bending machines, blowtorches, and hand tools. Include rod busters.
Electricians 635	Electricians and apprentices 575 & 576	Install, maintain, and repair electrical wiring, equipment, and fixtures. Ensure that work is in accordance with relevant codes. May install or service street lights, intercom systems, or electrical control systems. Exclude "Security and Fire Alarm Systems Installers." The 2000 category includes electrician apprentices.
Paving, surfacing and tamping equipment operators 630	Paving, surfacing and tamping equipment operators 594	Operate equipment used for applying concrete, asphalt, or other materials to road beds, parking lots, or airport runways and taxiways, or equipment used for tamping gravel, dirt, or other materials. Include concrete and asphalt paving machine operators, form tampers, tamping machine operators, and stone spreader operators.

Miscellaneous construction equipment operators, including pile-driver operators 632	Grader, dozer and scraper operators 855	Operate one or several types of power construction equipment, such as motor graders, bulldozers, scrapers, compressors, pumps, derricks, shovels, tractors, or front-end loaders to excavate, move, and grade earth, erect structures, or pour concrete or other hard surface pavement. Operate pile drivers mounted on skids, barges, crawler treads, or locomotive cranes to drive pilings for retaining walls, bulkheads, and foundations of structures, such as buildings, bridges, and piers.
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Figure E-2. (continued)
Occupational crosswalk for 1980 and 2000 IPUMS data

Census 2000 Occupational title and code	Census 1980 Occupational title and code	Job description for 2000 titles
Driver/sales workers and truck drivers 913	Truck drivers (heavy), truck drivers (light) and driver-sales workers 804, 805 & 806	<i>Driver/sales workers</i> drive trucks or other vehicles over established routes or within an established territory and sell goods, such as food products, including restaurant take-out items, or pick up and deliver items, such as laundry. May also take orders and collect payments. Include newspaper delivery drivers. <i>Truck drivers (heavy)</i> drive a tractor-trailer combination or a truck with a capacity of at least 26,000 GVW, to transport and deliver goods, livestock, or materials in liquid, loose, or packaged form. May be required to unload truck. May require use of automated routing equipment. Requires commercial drivers' license. <i>Truck drivers (light)</i> drive a truck or van with a capacity of under 26,000 GVW, primarily to deliver or pick up merchandise or to deliver packages within a specified area. May require use of automatic routing or location software. May load and unload truck. Exclude "Couriers and Messengers."
Crane and tower operators 951	Crane and tower operators 849	Operate mechanical boom and cable or tower and cable equipment to lift and move materials, machines, or products in many directions. Exclude "Excavating and Loading Machine and Dragline Operators."
Dredge, excavating and loading machine operators 952	Excavating and loading machine operators 853	<i>Dredge operators</i> operate dredge to remove sand, gravel, or other materials from lakes, rivers, or streams; and to excavate and maintain navigable channels in waterways. <i>Excavating and loading machine, and dragline operators</i> Operate or tend machinery equipped with scoops, shovels, or buckets, to excavate and load loose materials. <i>Loading machine operators, underground mining,</i> Operate underground loading machine to load coal, ore, or rock into shuttle or mine car or onto conveyors. Loading equipment may include power shovels, hoisting engines equipped with cable-drawn scraper or scoop, or machines equipped with gathering arms and conveyor.

First-line supervisors/managers of construction trades and extraction workers 620	Supervisors (categories separated): brickmasons, stonemasons, and tile setters; carpenters and related workers; electricians and power transmission installers; painters, paperhangers and plasterers; plumbers, pipefitters and steamfitters; n.e.c.; and extractive occupations 553-558 & 613	Directly supervise and coordinate the activities of construction or extraction workers.
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Figure E-2. (continued)
Occupational crosswalk for 1980 and 2000 IPUMS data

Census 2000 Occupational title and code	Census 1980 Occupational title and code	Job description for 2000 titles
Construction managers 22	Managers and administrators, n.e.c 19	Plan, direct, coordinate, or budget, usually through subordinate supervisory personnel, activities concerned with the construction and maintenance of structures, facilities, and systems. Participate in the conceptual development of a construction project and oversee its organization, scheduling, and implementation. Include specialized construction fields, such as carpentry or plumbing. Include general superintendents, project managers, and constructors who manage, coordinate, and supervise the construction process.

Note: All occupational groups include only individuals who work in the construction industry. By definition, this includes workers over the age of 16 who reported last working within five years of the Census survey.

Source: 2000 Census occupational titles and codes at <http://usa.ipums.org/usa/volii/00occup.shtml>, 1980 codes and titles at <http://usa.ipums.org/usa/volii/98occup.shtml>, job descriptions from the Bureau of Labor Statistics www.bls.gov.